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(12) # EUROPEAN PATENT APPLICATION

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(54) **Production of paper and paper board.**

(57) Paper or paper board is made by providing an aqueous cellulosic suspension containing a cationic polymer and then adding cationic starch or a high molecular weight synthetic cationic polymer, subjecting the suspension to shear, and then adding inorganic material selected from bentonite or colloidal silica. The process is of particular value when the suspension is formed from a mechanically derived pulp and/or deinked pulp and when the product is to be newsprint or board.

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Production of Paper and Paper Board

Paper or paper board is made by providing a thick stock, diluting the thick stock to form a thin stock, draining the thin stock to form a sheet and drying the sheet. The thick stock can be made either by mixing water into dried pulp or, in an integrated mill, by diluting a drained pulp.

It is standard practice to improve the process performance, or the product quality, by including various additives at one or more of these stages.

For instance, if the pulp from the which the thick stock is made is impure, the normal way of preparing it for drainage is by adding inorganic material, such as alum, talc or bentonite, at the pulping or thick stock stages. These treatments can have the effect of minimising problems due to pitch and other sticky materials.

If it is necessary to improve the strength of the final sheet it is common to include a dry strength resin, for instance a cationic starch, in the stock that is to be drained.

It is standard practice to include cationic polymers in the stock that is to be drained in order to improve drainage and/or retention.

Processes for improving retention are described in U.S. 4,388,150 and involve the addition of cationic starch and colloidal silicic acid to the stock before drainage. Such processes have been commercialised under the trade name "Composil" (trade mark).

Processes that give improved drainage, retention, drying and formation are described in EP 235893 and involve adding a first synthetic cationic polymer before a shear stage and bentonite after that shear stage. Such processes have been commercialised under the trade name "Hydrocol" (trade mark).

Although this process gives very good results in most instances, there is room for improvement with some stocks, especially impure stocks, and for some end products, for instance newsprint and board.

In the invention, paper or paper board is made by a process comprising providing a cellulosic suspension, subjecting this to one or more shear stages selected from cleaning, mixing and pumping stages, adding a main polymer, selected from substantially linear synthetic cationic polymer having molecular weight above 500,000 and cationic starch, before one of the shear stages and adding inorganic material selected from bentonite and colloidal silicic acid after that shear stage, draining the suspension to form a sheet and drying the sheet, and in this process there is a preliminary polymer inclusion stage selected from (a) the inclusion in the suspension before the main polymer of a low molecular weight water soluble synthetic cationic polymer having molecular weight lower than the molecular weight of the main polymer, and (b) the inclusion of a water soluble synthetic cationic polymer as a drainage aid for the drainage of cellulosic pulp when the suspension is made by draining a cellulosic pulp (in the presence of the drainage aid) and diluting the drained pulp.

The preferred aspect of the invention comprises the incorporation of the said low molecular weight water soluble synthetic cationic polymer.

The inclusion of the low molecular weight cationic polymer in the thin stock before addition of the main polymer can lead to improvement in the processing and performance properties obtained by the addition of the main polymer before a shear stage and bentonite or colloidal silicic acid after that shear stage. For instance, depending upon the other conditions, it can lead to reduced problems due to pitch and other sticky materials and can lead to improved wet and/or dry strengths, runability, drainage, linting, opacity and other paper qualities.

In this first aspect of the invention, the aqueous cellulosic suspension can be made either from dried pulp or, in an integrated mill, by diluting a drained pulp, all in conventional manner.

In the second aspect of the invention, the cellulosic suspension is made by diluting a drained pulp in an integrated mill and the drainage of the pulp is promoted by including a pulp drainage aid in the pulp that is to be drained, this draining aid comprising a water soluble cationic polymer. The cationic polymer for this purpose can be any of the synthetic polymers discussed below for use as the main cationic polymer.

When draining a pulp, in an integrated mill, to form a wet pulp that can then be diluted to make the thick stock and the thin stock, it is common to include no drainage aid in the pulp since drainage often occurs adequately without incurring the expense of a drainage aid. However in this aspect of the invention it is desirable to include a drainage aid since it promotes drainage and/or retention and provides a drained pulp that already contains cationic polymer and the inclusion of this cationic polymer has beneficial effects on the subsequent treatment with the described main polymer and the inorganic additive. For instance it can reduce the amount of main polymer that is required for optimum performance and the combined amount of drainage aid and main polymer may then be approximately the same as the optimum amount of main polymer if the pulp had not been treated with drainage aid. Thus by applying drainage aid the process

Table 2

Polymer B	Polymer A	Bentonite	Drainage	Pitch Count	Percentage Pitch Reduction
0	0	0	80	5.8×10^6	
0	0.025%	0.2%	49	1.7×10^6	70%
0.025%	0.025%	0.2%	35	1.2×10^6	79%
0.05%	0.025%	0.2%	31	5.1×10^6	91%

These examples clearly demonstrate the value of adding, for instance 0.01 to 0.1%, generally around 0.02 to 0.07%, polyethylene imine so as to reduce the amount of high molecular weight (for instance IV above 4) cationic retention aid that is required for good drainage and retention and so as to counteract the effect of stock having high cationic demand and, especially, high pitch count.

Example 3

Newsprint is made using a stock based on 3% kraft, 17% magnefite, 38% thermomechanical pulp and 42% groundwood, and to which 20% broke has been added. High molecular weight polymer is added, in some tests, just before the last shear stage and bentonite is added, in some tests, after the last shear stage. Low molecular weight polymer is added to the thin stock soon after it is diluted from the thick stock.

In these tests the low molecular weight polymer is polymer K which is a solution polymer of about IV 1 dl/g and formed from about 20% acrylamide and 80% by weight diallyl dimethyl ammonium chloride. The high molecular weight polymers are L, which is 70% acrylamide, 30% methyl chloride quaternised dimethylaminoethyl acrylate IV 8, and polymer M which is 95% acrylamide and 5% methyl chloride quaternised dimethylaminoethyl acrylate IV 11. The drainage rate for each of the treated suspensions is measured, with the best results being those that have the highest drainage figure. The results are as follows.

Table 3

Polymer K	High MW Polymer	Bentonite	Drainage
0	0	0	205
0.2%	0	0	195
0.2%	0	0.2%	300
0.2%	0.05%L	0.2%	335
0.2%	0.05%M	0.2%	340
0	0.05%M	0.2%	325

These results clearly demonstrate the benefit in the manufacture of newsprint from adding high molecular weight cationic polymer immediately before shear and bentonite after shear even when the high molecular weight polymer only has a relatively low cationic charge, and they also show that a useful result can be obtained when the high molecular weight polymer is replaced by a lower molecular weight polymer having molecular weight above 500,000, but that best results are obtained using a combination of both.

Claims

1. A process in which paper or paper board is made by forming an aqueous cellulosic suspension, passing the suspension through one or more shear stages selected from cleaning, mixing and pumping stages, adding a main polymer selected from cationic starch and high molecular weight water soluble cationic polymer to the suspension before one of the shear stages and adding inorganic material selected from bentonite and colloidal silica after that shear stage, draining the suspension to form a sheet and drying

the sheet, characterised in that the process includes a preliminary polymer inclusion stage selected from (a) adding to the suspension, before the addition of the main polymer, a low molecular weight water soluble synthetic cationic polymer having molecular weight lower than the molecular weight of the main polymer and (b) adding a water soluble, cationic, polymeric, drainage aid to a cellulosic pulp and then draining the pulp and diluting the drained pulp to form the aqueous cellulosic suspension.

2. A process according to claim 1 in which the main polymer is a high molecular weight linear water soluble cationic polymer having molecular weight above 500,000.

3. A process according to claim 2 in which the inorganic material is bentonite.

4. A process according to any preceding claim in which at least 25% by weight of the cellulosic suspension is formed from mechanically derived pulp and/or deinked pulp.

5. A process according to any preceding claim in which the product is newsprint or board.

6. A process according to any preceding claim in which the main polymer is a synthetic polymer having intrinsic viscosity at least 4dl/g or is cationic starch and a low molecular weight water soluble synthetic cationic polymer having lower molecular weight is incorporated in the suspension before the main polymer.

7. A process according to claim 6 in which the low molecular weight polymer has intrinsic viscosity below 2dl/g.

8. A process according to claim 6 in which the low molecular weight polymer has molecular weight 100,000 to 500,000.

9. A process according to any of claims 6 to 8 in which the low molecular weight polymer is selected from polyethylene imine, polyamines, polycyandiamide formaldehyde polymers, amphoteric polymers, and polymers of monomers selected from diallyl dimethyl ammonium chloruide, diallylaminoalkyl (meth) acrylates and dialkylaminoalkyl (meth) acrylamides.

10. A process according to any of claims 6 to 9 in which the low molecular weight polymer is an amphoteric cationic dry strength resin and the product is board.

11. A process according to any of claims 6 to 10 in which the suspension to which the low molecular weight polymer is added has a cationic demand, as measured on the main cationic polymer, of at least 400g/t and the amount of low molecular weight polymer that is added reduces the said cationic demand to below 300g/t.

12. A process according to any of claims 6 to 11 in which the suspension that is drained to form the paper or paper board is a thin stock formed by dilution of a thick stock and the main polymer is added to the thin stock and the low molecular weight polymer is present in the thick stock.

13. A process according to claim 12 in which the suspension that is drained to form the paper or paper board is a thin stock formed by dilution of a thick stock and the main polymer is added to the thin stock and the low molecular weight polymer is added to the thin stock or to the thick stock in an amount of from 0.01 to 0.5% based on the dry weight of suspension.

14. A process according to any preceding claim in which the suspension that is drained to form the paper or paper board is made by diluting a drained pulp that has been made by draining a cellulosic pulp containing a pulp drainage aid and in which the drainage aid comprises a water soluble, cationic, synthetic, polymeric drainage aid having intrinsic viscosity above 4dl/g.

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EUROPEAN SEARCH REPORT

Application Number

EP 89 30 2842

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
D,Y D,A	EP-A-0 235 893 (ALLIED COLLOID LTD) * Page 4, line 54 - page 20, line 16 *	1,2,4-6,9,12 3,13,14	D 21 H 23/76 D 21 H 23/16
P,Y P,A	US-A-4 795 531 (NALCO CHEMICAL CO.) * The whole document *	1,2,4-6,9,12 11	
A	EP-A-0 223 223 (BASF) * The whole document *	1-6,8,9,13	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

D 21 C
D 21 D
D 21 H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	27-09-1990	BERNARDO NORIEGA F.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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